Programming assignment 1
Introduction to time series analysis

August 31, 2023

Exercises

1. The following data show the sales of company X in successive 4-week periods over 1967–1970.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
1967	153	189	221	215	302	223	201	173	121	106	86	87	108
1968	133	177	241	228	283	255	238	164	128	108	87	74	95
1969	145	200	187	201	292	220	233	172	119	81	65	76	74
1970	111	170	243	178	248	202	163	139	120	96	95	53	94

(a) Plot the data.
(b) Assess the trend and seasonal effects.

2. Sixteen successive observations on a stationary time series are as follows:-

1.6, 0.8, 1.2, 0.5, 0.9, 1.1, 1.1, 0.6, 1.5, 0.8, 0.9, 1.2, 0.5, 1.3, 0.8, 1.2

(a) Plot the observations.
(b) Looking at the graph, guess an approximate value for the autocorrelation coefficient at lag 1.
(c) Plot x_t against x_{t+1}, and again try to guess the value of r_1.
(d) Calculate r_1.

3. For the airline passengers data already available in R, plot the autocorrelation function (ACF) for a range of lag values. Interpret the results.

4. Consider a time series with both trend and seasonal effects present. Model the time series as $X_t = a_0 + a_1 t + b_1 cos(\lambda t) + c_1 sin(\lambda t) + \varepsilon_t$, $t = 1, \ldots, 25$. Assume that $\lambda = \pi$. Estimate the above coefficients for the following time series data:
(2.7, 7.8, 6.2, 10.7, 9.6, 14.0, 13.2, 16.1, 17.9, 22.2, 23.7, 24.6, 24.6, 28.7, 28.6, 34.5, 34.1, 39.0, 38.7, 43.2, 42.3, 46.2, 46.3, 48.5, 49.8)